Action Plan Sand Dune Protection and Management Program

Preliminary Report - DNR 1984

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Communications from Governor James J. Blanchard

On Governors Office Letterhead

February 8, 1984

Dr. Ronald 0. Skoog, Director
Department of Natural Resources
7th Floor, Stevens T. Mason Building
P.O. Box 30028

Lansing, Michigan 48909

Dear Ron:

As the public official primarily responsible for the protection, management, and wise use of Michigan resources, you are- aware of the many threats to those resources and the competing interests for their use or preservation. As Michigan attempts to diversify its economic base, many are looking to Michigan's natural resources as a means of revitalizing the state's economy. While I am convinced that there is a role for natural resources to play in this effort, we must not lose sight of the fact that the significant natural resources which we in Michigan now enjoy must be protected for ourselves and future generations.

For this reason, I am requesting that the Department of Natural Resources undertake a special program which will ultimately lead to the long-term protection of one of our most special natural features--Great Lakes sand dunes.

Michigan s coastal dunes are a culmination of the effects of complex forces including wind, wave action, lake levels and currents and glacial activity. The. geological structures that resulted, and the subsequent. vegetation of those structures, are the highest, and longest freshwater dunes in the world.

It is fortunate that our coasts are graced by these magnificent natural features. Thousands of our citizens and visitors from other states are drawn to the dunes for their natural beauty, recreational opportunities, and the solitude and quiet which they can provide.

The presence of sand dunes along our coast not only provides a benefit but imposes an obligation. The State of Michigan must accept the responsibility for their fate. Even before the turn of the century, coastal dunes were the site of sand mining; and in more recent times, the expansion of our cities and the increase in leisure time have brought extensive residential and commercial. development on the dunes. This combination of factors has substantially eliminated coastal dunes in Indiana and Illinois. I believe

Michigan's coastal dunes must not suffer the same fate. While many of Michigan's most spectacular dunes have already been lost, we are fortunate that significant dune resources remain. Michigan's remaining dunes range from the impressive perched dunes of Sleeping Bear, to the lower but wider Van Buren dunes, and to the spectacular high relief and botanical diversity of the Grand Marais embayment in Berrien County. W~ must take steps now to prevent the incremental loss of these dunes and ensure their future existence.

At present, the only direct state program for dune protection is the Sand Dune Protection and Management Act, PA 222 of 1976. Although PA 222 has achieved some protection for the dunes, its effects have been limited. First, it regulates only mining activities. Second, only one permit has -been denied under the Act, and litigation has been a necessary prerequisite to maintaining the potential for dune protection in specific cases. Whether or not this litigation will be successful remains to be seen.

The only other source of legal protection for coastal dunes is zoning enacted by local units of government. Information on the number of such local zoning ordinances and whether or not they are providing any real protection to dunes is sketchy at best.

I am, therefore, requesting your assistance in compiling information necessary to develop measures that will ensure the long-term protection of the dunes. For each of the topic areas below, I would appreciate your submitting a preliminary report to the Natural Resources Commission and my office before .Tune 30, 1984. For areas where information is deficient, the report should include a recommended procedure for the timely collection of such data. The report should concentrate on those areas now classified as "Designated Dune Areas" under PA 222, 1976. The report should cover the following topics:

1. The natural values of Michigan's sand dunes, by specific sites and as a complete resource, including an analysis of their uniqueness within the nation's and world's sand dune resources.

2. Current land uses within Michigan's sand dunes and their effect on the dunes.

3. Existing local and state regulations and laws affecting or protecting uses of sand dunes, and deficiencies therein which inhibit maximum protection of Michigan's sand dunes.

4. The feasibility of the inland sand alternative for industrial uses.

5. Available inland sand resources on public land within Michigan, by specific sites.

6. Options for state or local laws, regulations, or policies that will provide long-term protection for Michigan's sand dunes.

I know you agree that protection of Michigan's sand dunes should be a high priority of natural resources management in the state. Because of substantial public concern over this matter, I ask that your activities in development of this information be conducted with maximum public involvement.

I look forward to working with you and your department on this important effort, and offer my personal commitment toward its accomplishment.

Sincerely,

James J. Blanchard, Governor

Communications from the Natural Resources Commission

Request of the Natural Resources Commission

Coastal Sand Dune Protection and Management Program Action Plan

The sand dune formations which have been created and shaped by the forces of nature constitute one of the most striking features on Michigan's landscape. These fragile and irreplaceable resources represent a culmination of the effects of complex forces including wind, wave action, lake levels and past glacial activity. The geomorphic structures that resulted, and the subsequent vegetation of those features, are the most significant and impressive freshwater dunes in the world.

Over the past century, development and mining have altered, or destroyed, many of the sand dune formations located primarily adjacent to the Lake Michigan shoreline. The Commission is deeply concerned over the likelihood of continuing loss and degradation of these resources. The Sand Dune Protection and Management Act does provide authority to the Department to regulate, control, and restrict mining operations contemplated within certain designated areas. However, the ability of the Department to develop and administer a comprehensive sand dune management program appears to have been hampered as a result of budgetary reductions and limited or nonexistent regulatory controls.

Governor Blanchard has likewise expressed his concern over this matter in his State of the State message to the citizens of Michigan. In addition, the Governor has formally requested that the Commission, through the Director, re-evaluate the manner in which the State's sand dunes have

been managed in years past and develop a strategy which may be considered for implementation in expanding and strengthening this important program.

The Commission strongly supports this endeavor. It is, therefore, appropriate and timely that a SAND DUNE PROTECTION AND MANAGEMENT PROGRAM ACTION PLAN be prepared for future consideration by the Commission.

The Commission hereby requests the Director to proceed with the preparation of a comprehensive report addressing the following:

1. The natural values of Michigan's sand dunes, by specific sites and as a complete resource, including an analysis of their uniqueness within the nation's and world's sand dune resources.

2. Current land uses within Michigan's sand dunes and their effect on the dunes.

3. Existing local and state regulatory programs affecting or protecting uses of sand dunes, and deficiencies therein, which inhibit maximum protection of Michigan's sand dunes. This may include proposed amendatory or new legislation to properly protect sand dune formations from conflicting land-use practices.

4. Establish a Department task force, including representatives of appropriate divisions, to review and evaluate the manner in which management decisions are formulated in dune-type environmental areas.

5. Update and re-evaluate proposed administrative rules relative to the provisions of the Sand Dune Protection and Management Act.

6. Develop recommendations that may be implemented in expanding fundamental research activities associated with the environmental values of sand dune formations. Priority attention should be directed toward the identification of industrial sand reserves in areas other than those found in the coastal zone. This shall include the availability of industrial sand resources on public land within Michigan, by specific sites. A methodology for financing research related programs shall also be appropriately addressed.

7. Update land ownership patterns and identify those sand dune formations that should be acquired by the State for appropriate public uses.

8. Prepare, for Commission consideration, a comprehensive sand dune management policy.

9. Develop recommendations and procedures providing for the incorporation of all data relating to sand dunes into the Department's Land Inventory Program.

An Action Plan for the development of the comprehensive report shall be submitted to the Commission by March 15, 1984. A preliminary comprehensive report addressing these, and other related topics associated with sand dune formations, shall be provided to the Commission by June 30, 1984. The Commission requests further that the activities required in the development of this information be

conducted with maximum public involvement.

Furthermore, the Commission strongly encourages the Legislature to give favorable consideration to the passage of S.B. 231 and to take all other steps necessary, including the appropriation of revenue, in the amount necessary to accomplish these endeavors.

Adopted by the Natural Resources

Commission

February 24, 1984

Correspondence to the Commission and the Public

On DNR Memohead

TO: Robert J. Compeau, Deputy Director
Keith Wilson, Acting Deputy Director
William Turney, Deputy Director

FROM: Ronald 0. Skoog, Director

SUBJECT: Task Force on the Sand Dune Protection and Management Program

Governor Blanchard and the Natural Resources Commission have requested an in-depth re-evaluation of the manner in which Michigan's coastal sand dune formations are managed by the Department.

Administrative and regulatory responsibilities associated with the provisions of the Sand Dune Protection and Management Act have been carried forth within the Reclamation and Mining Control Unit of the Geological Survey Division. There are, however, a number of other divisions in the Department where decisions are formulated that may impact and affect the structural integrity of designated sand dune areas.

In responding to the requests of the Governor and the Commission, it is essential that all internal operating policies, procedures, and objectives that the Department has maintained within dune-type environmental settings be documented and possibly re-evaluated.

I am, therefore, creating a task force within the Department to review and evaluate the manner in which management decisions are formulated in sand dune areas. The task force shall assume the additional responsibility of reviewing proposed land acquisition priorities, evaluating all Department projects and programs within sand dune areas including existing and proposed long-range plans, proposed construction, as well as maintenance projects, and grants-in-aid to local units of government.

The task force shall base its approach to this assignment on the principle that Great Lakes sand dunes are a unique and fragile natural resource necessitating maximum consideration given toward the protection of these features from conflicting land use practices. Priority attention of the task force will be directed toward the development of a comprehensive sand dune protection and management program action plan as requested by the Natural Resources Commission on February 24, 1984.

The task force shall be comprised of representatives of the following divisions and offices:

Environmental Enforcement	Forest Management
Wildlife	Geological Survey
Land Resource Programs	Budget and Federal Aid
Parks	Lands

The task force shall be chaired by Jon Roethele of the Geological Survey Division. Please notify Tom Segall by March 19, 1984 of each division's appointee.

cc: J. Butterfield; K. Hosford; R. Harmes; C. Guenther; D. Adams; H. Webster; J. Bails; R. Segall

Att.

Memorandum to the Natural Resources Commission

Re: Sand Dune Protection and Management Program Action Plan

FOR INFORMATION ONLY

On February 24, 1984, the Commission requested that the Department prepare a Sand Dune Protection and Program Action Plan for future consideration by the Commission. The methodology to be followed by the staff toward the fulfillment of this request was to be submitted to the Commission by March 15, 1984.

It is recommended that a comprehensive management plan addressing all relevant issues associated with Michigan's coastal sand dune formations be approached as an expansion of existing factual information developed by the Department through previous undertakings.

An analysis of this data will identify areas of deficiency or inadequacies where additional research or special studies may be needed.

The project shall be approached in three individual phases toward the subsequent preparation, and submission, of a preliminary report to the Commission by June 30, 1984.

Phase I of this project shall include and address the following subjects:

A. Chronological compilation of information, research programs, and reports that relate to location

and physical attributes of sand dune formations.

B. Specific information delineating the location of public ownership (Federal, State, and local) within designated sand dune areas and the data and manner in which public ownership was secured.

C. An annotated listing of all local regulations, zoning ordinances, and other limitations existing within the geographical limits of sand dune areas.

D. Existing legal provisions at the Federal and State levels regulating land-use practices within sand dune areas.

Phase II of the project shall address inadequacies and deficiencies in existing information. It will include:

A. Adequacy of the data base relating to known surface (environmental) values of sand dune formations on publicly owned lands.

B. Trends in public and private land-use patterns within the coastal zone.

C. Documented impacts of sand dune formations on the environment as well as the impacts of public and private use on these geomorphic features.

D. Documented deficiencies in regulatory controls at respective levels of government.

E. A compilation of information relating to sand as an industrial product and geographical locations where reserves appear to exist that may be utilized to meet future economic needs.

Phase III shall be devoted to the formulation of recommendations for future action. It will include:

A. Proposed new, or amendatory, legislation, if needed.

B. A proposed comprehensive sand dune management policy.

C. A proposed priority list of individual sites located within sand dune areas that should be acquired for appropriate public uses.

D. Proposed research projects and the costs thereof.

E. Recommended procedures for the incorporation of all data relating to sand dune environmental systems into the Department's Land Inventory Program.

The report, as requested, will be directed by appropriate staff within the Geological Survey Division. In addition, a Department task force has been established to provide assistance in this effort. The task force includes representatives from eight different divisions within the Department.

It is our intent to fulfill this request with a maximum amount of participation from the public.

RONALD O. SKOOG, Director

On DNR letterhead

May 21, 1984

Dear

The coastal sand dune formations that parallel portions of Michigan's Great Lakes shoreline are a fragile and irreplaceable part of our natural heritage. Younger than the pyramids of Egypt--and, dramatic in their forms--the sand dunes of the Lake Michigan shoreline, in particular, are features of national celebrity. Nature has shaped and reshaped the Great Lakes region, fashioning the coastal zone that skirts the lakeshores. Here one finds a range of landscapes: wetlands, rocky outcroppings, beach ridges, and plateaus. But nowhere is the sculpting of natural forces more evident than in the dunes themselves.

A broad variety of land use practices have continued over years past thereby creating various degrees of environmental impacts on these fragile geomorphic features. In certain instances, these practices have impaired, damaged, or destroyed the structural function of sand dune systems.

Recently, Governor Blanchard and the Michigan Natural Resources Commission requested that a comprehensive sand dune protection management program action plan be prepared by staff within the Department of Natural Resources. The primary purpose of this effort is that of identifying specific areas of deficiency, insofar as management programs are concerned, and proposed solutions to identifiable problem areas.

A "preliminary report" addressing the subject action plan is scheduled for completion on, or about, July 1, 1984. In view of the significant amount of public interest associated with controversial issues contemplated within designated sand dune areas it is appropriate that the public be offered an opportunity to participate in the development of the action plan.

The has expressed an ongoing interest in issues

associated with Michigan sand dune formations. The purpose of this letter is to inform you that a draft copy of the report shall be provided to you within the near future. Any appropriate comments that you may wish to offer regarding this subject will be welcomed.

Please feel free to contact me for any additional information concerning this matter.

Sincerely,

Jon W. Roethele, Supervisor, Reclamation and Mining Control Unit, Geological Survey Division, Attachment

Addresses

receiving Jon Rothele's letter:

1. Mr. Frank Ruswick, Jr.
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2. Mr. Edward Ketterer
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3. Mr. Tom Washington
Michigan United Conservation
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Lansing, MI 48912

4. Mr. Arnold Petkus
Michigan Industrial Sand Assoc.
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5. Mrs. Merrill Clark
League of Women Voters
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6. Mr. Chris Graham
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7. Mr. Tom ~i~i~de
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8. Ms. Carol Dansereau
Michigan Environmental Council
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9. Mr. ~n Wilson
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-J P.O. Box 147
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10. Mr. George Graff
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11. Mr. John LaPose
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12. Dr. James R. Wells
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13. Ms. Susanne Dye
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14. Central upper Peninsula
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15. West Michigan Regional.
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16. West Michigan Shoreline
Regional Development
Commission
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17. Eastern Upper Peninsula
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18, Southwestern Michigan
Regional Planning Commission
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19. Northwestern Michigan
Regional Planning Commission
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Traverse City, MI 49684

20. Mrs. Marcia Blair
Land Use Chairman
League of Women Voters
200 Museum Drive, Suite 202
Lansing, MI 48933

Preface

The coastal sand dune formations that parallel portions of the Great Lakes shoreline are a natural resource which have been a subject of public interest for many years. The diversification of environmental elements - topographic relief, vegetation, wildlife habitats, and climatic conditions - found naturally occurring within these landforms represents a phenomena unique to the State of Michigan. The vegetation and ecology of Lake Michigan's sand dunes were of interest even before the turn of the century. It was with the 1899 work of H. C. Cowles on sand dunes that basic principles of plant succession were developed in the United States. Further work on dune ecology helped pioneer our understanding of plant community relationships, resulting in the concept of "climax" vegetation which is defined in reference to a community that exists in a state of dynamic equilibrium with the environmental regime at that particular locality.

Michigan's oldest dunes, those of the Algonquin series, are approximately 13,000 years in age. The majority of the coastal Lake Michigan dunes are of the Nipissing age, about 3,500 years old and, as such, are among the state's youngest geomorphic features. These dunes were formed when the lake level was some 25 feet higher than present levels, although many individual dunes and sand dune formations continue to be rearranged by wind and water action.

Michigan's dunes collectively represent the world's largest accumulation of sand bordering a body of fresh water. The shoreline is marked with broad sandy beaches, low shore foredunes, massive dune bluffs--some open and desertlike, others stabilized with a rich hardwood forest cover. These natural features are of significant importance to the state's economy because the superb scenic and aesthetic values of "duneland" serve as an attractant for the tourist industry, as do the opportunities for water-oriented recreation, hiking, camping, and nature study. In some cases, this rugged environmental setting is the last refuge for unique assemblages of plants and animals. In addition, the dunes have been utilized for a variety of industrial, residential, and commercial purposes. A significant volume of high quality industrial sand that is utilized annually for economic purposes has been produced at mining properties located within sand dune areas. Villages and cities, subdivisions, resorts, homesites, energy producing facilities, and industrial complexes have been constructed within, or in close proximity, to sand dune formations.

The impact of human activities within the dunes became a matter of concern to Michigan legislators in the early 1970's. In 1976, the Sand Dune Protection and Management Act was enacted, thereby providing the Department with the authority to regulate mining operations within designated sand dune areas. The Act also required that the Department was to conduct a number of comprehensive studies associated with sand dune formation and sand as a mineral resource. This legislation, however, related solely to "sand dune mining operations"-- all other land use practices were exempt from regulatory controls.

On February 8, 1984, Governor Blanchard expressed his concern over the apparent absence of a comprehensive sand dune management program within the Department of Natural Resources. In his letter to Director Skoog the Governor stated:

"I am requesting your assistance in compiling information necessary to develop measures that will ensure the long-term protection of the dunes.

On February 24, 1984, the Natural Resources Commission likewise expressed their concerns over this particular issue. The Commission formally requested the Director to prepare a SAND DUNE PROTECTION AND MANAGEMENT PROGRAM ACTION PLAN addressing a number of critical issues relating to these resources. A preliminary report containing pertinent information and recommendations was requested by June 30, 1984.

This report has been compiled in fulfillment of the requests of the Governor and the Commission. It is a preliminary report providing a foundation of information for further expansion and elaboration. It is recognized that the recommendations contained within the report may prove to be controversial in nature or conflict with established private, and public, land-use practices.

Nonetheless, with all the environmental values inherent in our dunes, it is obviously important that steps be taken to preserve them. The climatic and geological conditions that created them no longer exist, so if the dunes are destroyed, they are not likely to ever regain their present size and extent. The sand dune environmental system is a special, fragile place - one that deserves our protection as a truly unique resource. - Jon W. Roethele

Introduction

This preliminary report shall bring forward, and summarize, pre-existing information and factual findings associated with the physical characteristics and respective environmental values of that portion of the Michigan Great Lakes shoreline conforming to the definition of a designated, or proposed. sand dune area. A sand dune area is defined in the Sand Dune Protection and Management Act as:

those geomorphic features composed primarily of sand,

whether windblown or of other origin, and which lies within 2 miles of the ordinary high-water mark on a Great Lake.

Coexisting within the boundaries of sand dune areas are landforms classified as barrier dune formations. Criteria for barrier dune boundary is determined as follows:

A. A barrier dune is a relatively permanent feature.

B. The inland boundary of a barrier dune formation is that landward boundary line at the most landward base of the first sand dune formation from the Great Lake shoreline which displays the greatest relative relief within a designated sand dune area.

C. The shoreland boundary is that boundary line at the most shoreward base of the first sand dune formation from the Great Lake shoreline that is not ephemeral (temporary) in nature.

D. The boundary of a barrier dune shall be easily recognized on aerial photographs (stereo-paired aerial imagery).

E. A barrier dune is a landform (geomorphic feature) whose relief and location restrict and impede interaction between the Great Lakes shoreline and inland oriented activities. Barrier dunes frequently exhibit recognizable aesthetic values.

More than 3,200 miles of Great Lakes shoreline lie within the State of Michigan and, of this, approximately 270 miles (or 275,000 acres) are included as “sand dune areas.” Located within these sand dune areas are approximately 25,000 acres of “barrier dune formations” - these areas are commonly viewed by the general public as the areas of greatest environmental sensitivity.

The preparation of this action plan was pursued in three (3) separate phases.

Phase I includes the following:

A. A chronological compilation of information research programs and reports that relate to the location and physical attributes of sand dune formations.

B. Specific information delineating the location of public ownership within designated areas and locations when land acquisition had been accomplished.

C. An annotated listing of local regulations, zoning ordinances, and other limitations existing within the geographical limits of sand dune areas.

D. Existing legal provisions at the Federal and State levels regulating land-use practices within sand dune areas.

Phase II shall address inadequacies and deficiencies in existing information. It includes:

A. The adequacy of the data base relating to known surface (environmental)

values of sand dune formations on publicly-owned lands.

B. Trends in public and private land-use patterns within the coastal zone.

C. Documented impacts of sand dune formations on the environment, as well as the impacts of public and private use on these geomorphic features.

D. Documented deficiencies in regulatory controls at respective levels of government.

E. A compilation of information relating to sand as an industrial product and geographical locations, other than sand dune formations, where reserves appear to exist that may be utilized to meet future economic needs.

Phase III shall be devoted to recommendations for potential future action.

A Department Task Force was established by Director Skoog for the purposes of reviewing and evaluating the manner in which management decisions are formulated within sand dune areas. This Task Force is comprised of representatives of the following Divisions and Offices:

Environmental Enforcement	Forest Management
Wildlife	Budget and Federal Aid
Land Resource Programs	Lands
Parks	Geological Survey

Information and data contained within this compiled by Task Force members.

In addition, a total of 20 different organizations were

informed of the nature of this particular effort and were invited to provide input into the development of the report.

Detailed information including reports, plans, maps, and statistics referenced in this report are retained in the files of the Geological Survey Division.

Phase I

Research

Sand dune formations and sand as an industrial mineral resource have been a subject of significant interest to geologists, ecologists, biologists, and others trained and educated in the fields of scientific endeavor for many years.

The literature on dunes is extensive - no less than 170 different articles, papers, manuscripts, and books have been published over the years relative to these resources. However, all except a small portion has been published in Europe. Most of the important contributions on coastal sand dune formations have been developed in Germany, Denmark, Holland, and Belgium. In North America, inland dunes have received more study than coastal dunes even though the latter cover a great extent of the shoreline and are imposing geomorphic features.

Although Great Lakes sand dune formations exist in extensive areas of the coastal zone, relatively little scientific research has been published regarding these landforms. Individual areas, such as the Grand Mere Embayment, Sleeping Bear Dunes, and the Grand Sable Dunes have been the subject of specialized research projects in years past. Reports of particular interest are the efforts of G.C. Tague (1946), "The Post-Glacial Geology of Grand Marais Embayment, Berrien County," and "The Glacial and Post-Glacial History of the Platte and Crystal Lake Depression, Benzie County," H. C. Cowles (1899), "The Ecological Relations of the Vegetation of the Sand Dunes of Lake Michigan," and the "field notes" of I.D. Scott (1920, 1927, 1930, 1934, 1938, 1939, 1942) relating to the evaluation of Michigan's shoreline dunes.

In 1977, a concerted effort was initiated within the Department to develop additional information relative to the environmental and economic values of Michigan's sand dune formations. The Sand Dune Protection and Management Act (Section 3) clearly and concisely defined the subjects to be addressed in these efforts. Cooperative projects were initiated between the Department and Michigan State University, U.S. Army Corps of Engineers, The Institute of Mineral Research-Michigan Technological University, Muskegon Community College, and the Cranbrook Institute of Science for various types of research projects. In addition, staff within the Geological Survey Division did proceed to inventory the entire Michigan Great Lakes shoreline for the purposes of classifying and delineating the exact location of "sand dune areas" as defined in the previously referenced statute.

A research project entitled "Dune Type Inventory and Barrier Dune Classification Study of Michigan's Lake Michigan Shore" resulted in the establishment of a dune morphology classification index. This classification is based on dune form, relative relief, orientation, arrangement, and the relationship of the dune assemblage to the underlying geologic formation. Nine different dune forms are recognized in this classification index. Each assemblage of these forms may be expressed as having high, moderate, or low relative relief. With respect to the present shoreline, parallel, perpendicular, arcuate or irregularly oriented formed are possible; and, within each area, a single or multiple number of individual dune forms of the same type may be designated. Dune assemblages may be nonelevated, or they may be perched on top of, or override a steep slope of a non-dune formation.

The classification system was applied to all sand dune areas identified in the previously conducted inventory. Specific information was recorded on 7.5 minute U.S. Geological Survey mylar base topographic maps.

Concurrently with this effort, the Department proceeded to develop a data base of information relating to the environmental elements and ecosystems existing within sand dune formations in various geographical locations along the Great Lakes shoreline. This project was directed by Dr. James Wells, Cranbrook Institute of Science. Consultation, as to methodology and conclusions, included Dr. Warren Wagner, Dr. Edward Voss, and Dr. William Benninghof of the University of Michigan, as well as Dr. Sylvia Taylor of the Department. Site specific reports were prepared for each project undertaken.

The Department also received assistance from the Institute of Mineral Research-Michigan Technological University in conducting a geologic study of sand deposits in Michigan (areas other than sand dune formations). The U.S. Army Corps of Engineers financed this effort. The project involved a review of existing geological information, field evaluations,

laboratory analysis, and testing procedures. In addition, deposits of silica sand were also collected through a sampling program involving deep-water reserves at numerous Lake Michigan off-shore locations.

In cooperation with the Remote Sensing Laboratory at Michigan State University, a "land use change analysis" was conducted. This project focused on the location and character of land lying within "barrier dune formations" that was converted from a "non-developed" to a "developed" condition (residential, commercial, industrial, etc.).

The Department of Resource Development at Michigan State University also prepared a report entitled, "Criteria and Methodology for Assessing the Environmental, Economic, Aesthetic, and Sociological Impact of Mining in Michigan Sand Dune Areas." This effort did identify the fact that a substantial amount of information must be acquired before it can be determined exactly what impacts barrier dune formations have upon the environment. For example, an obvious void in the data base is the micro and macro climatic conditions that exist within, and adjacent to, designated sand dune areas.

Mining

The mining of coastal dune sand continues to be an important component of the industrial sand mining industry. The eleven (11) sand dune mining firms which currently operate in Michigan maintain an ownership interest in over 5,700 acres of land at twenty-seven (27) sites. Sand dune mining permits have been issued for operations at sixteen (16) of these locations. Industrial sand produced in Michigan is supplied to over 2,500 customers annually. It is also relevant to note that industrial sand produced in Michigan from all locations - sand dune formations, inland sites, and dredge sands - amounted to 5.5 million tons in 1976. Of this total, 3.6 million tons were produced from within sand dune areas. In 1983, approximately 2.0 million tons were mined from within sand dune formations. Primary utilization of sand as a mineral resource is its application to the foundry industry as a base material for cores and moulds. Over 96% of Michigan s annual production is used for those purposes, whereas the balance is utilized for glass, fiberglass, sandblasting, and other practices. Recent changes in foundry practices, coupled with consumer demands imposed upon the automotive industry, have impacted the sand dune mining industry. Future demand for these resources as an industrial mineral are somewhat uncertain, however there is evidence to document the fact that sand produced at inland and/or off-shore sites are available in a quantity necessary to meet the needs of several future generations. It is also highly probable that a significant percentage of these future reserves are located on lands presently under the jurisdiction of the Federal or State Government.

Land Matters

Public ownership within Michigan's 275,000 acres of sand dune areas is approximately 110,000 acres of land. Of this total , 32,100 acres are administered within the Department of Natural Resources - the balance being under the jurisdiction of the Federal Government (National Park Service i.e. Sleeping Bear Dunes and Pictured Rocks National Lakeshores and the U.S. Forest Service), as well as local units of government. Several privately administered dune "natural areas" are also maintained by educational institutions or other organizations. The most expansive block of public dune ownership is the Sleeping Bear Dunes National Lakeshore (60,000 acres of land including North and South Manitou Islands). Remote sand dune environmental systems are also located on several of the islands comprising the "Beaver Island Group" (North and South Fox, Garden, and High Islands, as well as portions of Beaver Island). The majority of the state ownership is managed for various types of state park purposes. It is also relevant to note that 5,900 acres of land lying within sand dune areas has been acquired between 1960 and the present by the Department for public uses.

The overriding majority of these ownership transactions have been accomplished by purchase on a "willing seller-willing buyer" basis at fair market (appraisal) value.

Land Use

Over 150,000 acres of the designated (or proposed) sand dune areas are in private ownership. These lands currently are utilized for agricultural, residential, commercial, or industrial purposes. Privately owned "barrier dune formations" have been extensively exploited for residential purposes (permanent and seasonal dwellings alike). Serious erosion problems exist in areas where homesites have been located in high relief areas bordering the Lake Michigan shoreline. In other settings, condominium complexes and multifamily developments have been constructed in sensitive environmental settings. In addition, energy producing facilities have been constructed within

portions of barrier dune formations at several locations. Transportation corridors including limited access highways, county, local, and private roads have likewise impacted the physical characteristics of coastal sand dune formations. Only in relatively small, isolated locations man s "handiwork-of-progress" is yet to be fulfilled. Each respective local unit of government was contacted, as a part of this study, for the purposes of ascertaining the type, and extent, of local land use controls that exist within their area of jurisdiction.

A total of twelve (12) counties, forty (40) townships, and twelve (12) cities or villages were requested to share the nature and extent of local controls that presently exist within their areas of jurisdiction. These governmental entities are located within the current boundaries of designated sand dune areas.

In addition, it is also relevant to note that several statutes administered and enforced by the Department also relate to existing, or proposed, land use practices within sand dune areas. These statutes include, but are not necessarily limited to, the following:

- The Inland Lakes and Streams Act
- The Soil Erosion and Sedimentation Control Act
- The Shorelands Protection Act
- The Wetlands Protection Act
- The Wilderness and Natural Areas Act
- The Endangered Species Act
- The Submerged Lands Act
- The Natural Rivers Act
- The Michigan Environmental Protection Act
- The Oil and Gas Act
- The Mineral Wells Act
- The Water Resources Commission Act

Pre-existing Department or Divisional policies, with respect to land use practices on state-owned lands lying within the boundaries of sand dune areas, have likewise impacted these natural resources. A total of thirteen (13) state parks are administered by the Department for various types of public outdoor recreational activities. Facilities may include campgrounds, picnic areas, nature centers, roads, utility systems, administrative offices, trails, and other types of developments. The operation of off-road recreational vehicles (dune buggies and other similar contrivances) is permitted, and regulated, at one (1) state park facility. Developments of this type do exist within barrier dune formations - in some cases, they have been constructed immediately adjacent to the Great Lakes shoreline. Public use of these facilities is significant - in 1983 attendance recorded at these thirteen (13) state parks was 7,210,448 individuals. Outdoor recreation on these lands does occur on a year-around basis. In winter months, cross-country skiing appears to be increasing in popularity and snowmobile use is permitted at various locations.

Projects and Grants

The Department has been involved in basically three (3) funding programs that have resulted in a substantial amount of revenue being allocated for projects within sand dune areas. These projects have been funded through three (3) different programs; these being:

- The Land and Water Conservation Fund
- The Michigan Land Trust Fund
- The $30 Million State Recreation Bond Fund State or local projects, completed or contemplated, include the following funded amounts:

Berrien County	2,072,950
Ottawa County	751 ,700
Allegan County	1,468,300
Muskegon County	1,281 ,290
Oceana County	493,900
Mason County	325,100
Benzie County	243,200
Leelanau County	1,137,400
Emmet County	1,156,500
TOTAL	$ 8,930,340

These various projects include land improvements to existing facilities. In revenues were added to these projects to acquisition, new developments, or many instances, either state or local obtain the grant for the particular project.

Summarization of Phase I

Research

I. Research programs and comprehensive studies relating to sand dune formations as a geomorphic feature and sand as an industrial mineral have been carried forth in Michigan and elsewhere over a substantial period of time. Areas of 'special interest"

have received the focal point of attention insofar as environmental values are concerned. Specialized studies initiated since the passage of the Sand Dune Protection and Management Act have significantly broadened and expanded the data base of ecological succession occurring within these formations, thereby substantiating, in large part, the sensitivity of Michigan's sand dune areas.

Mining

II. The production of industrial sand from designated sand dune areas continues, however, on a very limited scale. The industry appears to have stabilized in annual production volume. Customer specifications (foundry related) for industrial sand continue to be modified as a result of technological changes occurring in the automotive and heavy equipment industry. Corporations engaging in industrial sand mining operations have broadened their geographical base from Michigan to other locations in the Midwest and elsewhere. Corporate ownership transactions are likely to affect the volume of industrial sand produced from within dune-type formations. Additional information has been obtained on the nature of industrial sand deposits located in areas other than the coastal zone.

Land Matters

Over forty percent (40%) of Michigan's sand dune areas are in public ownership. The Department of Natural Resources currently administers approximately twenty nine percent (29%) of the publicly-owned dune-type formations; the balance being administered by Federal and local units of government. Land acquisition efforts by the Department have resulted in the consolidations of state ownership within existing projects, as well as the establishment of new projects. State projects are administered primarily by the Parks Division. These projects include:

Grand Haven State Park	48	acres
Grand Mere State Park	393	acres
P. J. Hoffmaster State Park	1,043	acres
Holland State Park	143	acres
Leelanau State Park	1,307	acres
Ludington State Park	4,514	acres
Mears State Park	49	acres
Muskegon State Park	1,124	acres
Saugatuck State Park	909	acres
Silver Lake State Park	2,765	acres
Van Buren State Park	326	acres
Warren Dunes State Park	1,502	acres
Wilderness State Park	7,554	acres
TOTAL	**21 ,677**	**acres**

(NOTE: Portions of individual state park lands may be located outside of the boundary of a designated sand dune area.)

Total state ownership is 32,100 acres of land; the Forest Management Division and Wildlife Division jointly administer 10,423 acres, the majority of which is located in the Beaver Island Group.

The Sleeping Bear Dunes National Lakeshore includes the largest amount of public ownership exhibiting fresh water coastal sand dune formations in the United States. This 60,000 acre project was authorized by the United States Congress in 1970. Land acquisition costs, once completed, will exceed sixty (60) million dollars. In addition, the Grand Sable Dunes, which are included within the boundary of the Pictured Rocks National Lakeshore adjacent to the Lake Superior shoreline, are another reservoir of resources of outstanding natural and scenic quality.

Land Use

Approximately sixty percent (60%), or over 150,000 acres, of designated sand dune areas are in private ownership and are being utilized for a variety of residential, commercial, or industrial purposes. Local land use regulations vary from township-to-township and from municipality-to-municipality - Some being very comprehensive in nature; others very weak or non-existent. Of particular concern is the likelihood of exploitation of the remaining undisturbed barrier dune formations that are in private ownership (excluding mining company ownership). A "Land Use Change Analysis Study" was conducted for the Department by the Center for Remote Sensing - Michigan State University, in late 1980. This study did analyze land use characteristics of twenty-two (22) square miles (14,161 acres) of Lake Michigan barrier dunes not in public or mining company ownership. This study concluded that less than one-fifth (18%) of this sensitive environmental zone has been developed to date. The results of the change direction analysis show that 754 acres of land development has occurred on these formations since 1963. Although this represents only 5.3% of the total study area, it reveals that 29.6% of all previously developed land became so in just the last fifteen (15) years. The majority of new development was in the form of low density residential development (less than one (1)

dwelling unit per acre). The vast majority (76%) of these new developments occurred in the forested areas of the barrier dune formations, although 14% of it took place in areas of dune grass, herbaceous or shrub cover. Only 5% of the total development in the last fifteen (15) years occurred on already unvegetated areas of these sand dune formations. Low density residential development includes areas at least 2.5 acres in size having less than one residential dwelling unit per acre. Low density residential development therefore appears to have accounted for 80% of all land development in these barrier dune formations since 1963.

Land use policy on publicly-owned lands does vary considerably and is contingent upon which agency is responsible for the administration of those lands. The Federal Government, through the National Park Service, has recommended that a significant percent of the Sleeping Bear Dunes National Lakeshore be established as Federal Wilderness pursuant to the Federal Wilderness Act of 1964. Such action, if and when accomplished, would include the majority of the barrier dune formations located within this project. In the interim, National Park Service management plans significantly restrict public use within these areas. Similar conditions apply to the Grand Sable Dunes in the Pictured Rocks National Lakeshore.

Legislation is pending in the United States Congress establishing the "Nordhouse Dunes," Huron-Manistee National Forest, as a "RARE II Wilderness Area." This proposal includes approximately 2,830 acres of public land lying immediately adjacent to the northern boundary of the Ludington State Park, Mason County. Thus far, United States Forest Service management policies have remained consistent with this proposed action.

However, Department policy on state-owned lands lying within designated sand dune areas - barrier dunes in particular - remains "flexible" from project-to-project. Statewide forest management, wildlife, and state park policies apply to the management of forest cover, wildlife habitats, and recreational developments within these natural resources. It is a fact that the absence of a comprehensive policy addressing this subject has proven to be a subject of controversy between those who favor expanded developments and uses and those who support the opposite viewpoint.

Phase II

This phase of the preliminary report shall address inadequacies and deficiencies in existing information referenced in PHASE I. At this point, it is recognized that a substantial amount of data and factual findings relating to Michigan's coastal sand dune formations have been compiled over years past. The individual efforts of persons engaging in these previous efforts is recognized, for they have identified, in part, the irreplaceable values of these magnificent resources. The titles referenced in PHASE I; these being, RESEARCH, MINING, LAND MATTERS, and LAND USE are heretofore analyzed.

Research

Comprehensive studies and research projects of various types that have been carried forth identify the manner in which the coastal sand dune formations were created, their evolvement into becoming stabilized features on the Michigan landscape, and the sensitivity of ecological inter-relationships that continue within individual sand dune areas. The "uniqueness" of these resources to Michigan has been documented to the extent that no environmental system of comparable quality exists from a global perspective.

On-site field research projects associated with indigenous vegetation do indicate a high diversity of ecosystems and ecotones existing within relatively small areas and distances. Diversification of this magnitude is a clear and concise indicator of significant variations in micro-climatic conditions including air and soil temperature, relative humidity, wind direction and velocity, and available light energy. Coupled with these factors is the absence of developed soil horizons and low nutrient availability. Transition zones exist from the sterile (unvegetated) dry beach immediately upland from the water's edge to a perpetuating climax forest type existing, in some instances, two hundred (200) feet inland. It is also concluded that plant succession in these settings is an extremely slow process in development. Consulting ecologists advise that centuries of time are required to develop such systems. Furthermore, "topsoil" in the commonly accepted term does not exist in sand dune formations. Rather, a thin mantel of organic debris (humus), frequently less than two (2) inches in depth, is deposited over the sand dune formation. Individual dunes, or sand dune systems, are usually a homogenous deposit of sand - sometimes 150-200 feet in thickness - overlying other types of geologic features. Therefore, precipitation percolation is rapid carrying with it the nutrients made available through the decomposition of leaves, limbs, logs, and other organic debris.

Gravel and clay deposits frequently underlie dune sand thereby creating a hydrologic (groundwater) regime that varies considerably within small distances. Similarly, interdunal ponds or wetland features may be encountered in valleys separating individual sand dune formations. Situations of this type frequently present problems in obtaining an acceptable potable water supply for domestic purposes and/or in designing private residential sewage systems when municipal service does not exist.

The impact that sand dune systems - barrier dune formations in particular--exhibit upon micro-climatic conditions is somewhat speculative insofar as longterm affects are concerned. It is a fact that agriculture is a major type of land use practice on inland areas located easterly of designated sand dune areas. Agricultural products including peaches, pears, cherries, grapes, apples, asparagus, and many, many others thrive in these areas. The influence of Lake Michigan insofar as temperature and moisture is concerned is documented, however, the direct effect of high-relief dunes upon these conditions has not been ascertained.

It is also an established fact that coastal sand dune formations support a high population of migratory non-game wildlife during spring and fall seasons. Many species breed and nest in these areas, as well. Shoreland systems located lakeward of dunes provide habitat and food for a wide variety of species utilizing these types of environmental settings. Research projects relating to wildlife populations in these zones have been limited to certain individual areas.

The impact of human use within Michigan's sand dune areas has not been documented to date. A project of this nature has been initiated by the National Park Service at three (3) locations; Indiana Dunes National Lakeshore, Sleeping Bear Dunes National Lakeshore, and the Pictured Rocks National Lakeshore. Studies of this nature have been conducted in similar settings elsewhere in the United States and in Europe. A research project of particular interest entitled, "Studies on the Impact of Paths on the Dune Vegetation at Winterton, Norfolk, England" was prepared by L.A. Boorman and R.M. Fuller in 1977. Portions of their conclusions are as follows:

"There appears to be a differential reaction to pedestrian or vehicular traffic among plant species. European beachgrass is about ten times more susceptible to damage from traffic than associated species. Trampling tolerance also varies with location and season. It was also found that 1,061 tramples in summer reduced the cover of dune vegetation by 50 percent, whereas 1,828 tramples in winter were required to cause the same level of damage. At Holkham, England, a heavily used path (20 meters wide) was produced by a double trip of 35,000 people per year. It was also found that approximately 150 tramples were required to produce 50 percent bare ground on a single track less than 0.5 meters wide. The low number of passes required to produce 50 percent bare ground was attributed to the low productivity of vegetation in the area."

(NOTE: European beachgrass is of the same genus of beachgrass that is commonly found in Michigan sand dune formations *(Ammophila).)*

Techniques and methods necessary to achieve stabilization and revegetation of eroding sand dune formations in Michigan is admittedly limited. It is a fact that if stabilizing vegetation is removed, either by human or natural occurrences, erosion problems can become immediate and severe in nature. The encroachment of windblown sand into adjacent developed or undeveloped areas is well documented in Michigan's coastal zone. Residential developments, utility systems, and public and private roads have been rendered useless from these occurrences. Poorly planned developments of various types have created significant problems to landowners and to their neighbors. In addition, the indiscriminate or uncontrolled operation of off-road vehicles is clearly evidenced in sand dune formations. Stabilizing vegetation has been destroyed or damaged to the point where wind-related erosion problems continue at a growing pace.

Mining

The future utilization of sand as an industrial mineral in the foundry related industry is expected to continue into future years. It is possible that the use of this product by the automotive industry may decline, however the "art" or "science" of sand casting is a well established technique in meeting the demands of our modern society. The states of Indiana, Illinois, California, Texas, New Jersey, and others, likewise supply this resource to consumers. Long-term production of industrial sand from Michigan's sand dune areas relates directly to economic factors - sand of comparable quality can be produced at "non-dune" locations usually at a higher cost per unit ton. Coupled with this is the fact of escalating transportation costs. The cost of industrial sand to the customer varies significantly

and is contingent upon the users specifications. Unit cost (per ton) may vary from two dollars ($2.00) up to one hundred dollars ($100.00), or more, depending upon a variety of factors. It is, however, a fact that Michigan sand deposits are a result of glacial action. Michigan sand dunes were created by basically two (2) natural forces - wind and water. These two forces, acting together over long periods of time, resulted in deposits of sand very "similar" in grain shape and grain size being deposited in large dunes readily accessible to mineral producers. Inland deposits of sand were also created by similar occurrences in certain regions of the state. However, these deposits are often co-mingled with gravel, other minerals, or clay. Inland sand deposits may also be thin in depth (thickness) or of unacceptable grain shape (angular sands).

It is also acknowledged that extensive deposits of industrial quality sand exist on Great Lakes bottomlands. Sands of this type were produced at a location in Saginaw Bay for many years through the utilization of dredging equipment. Department files indicate no significant adverse environmental impacts from this long-term operation. Dredge sands obtained for the purposes of maintaining navigation channels also have potential uses as an industrial mineral. These sands are presently utilized for beach nourishment or are disposed of in deep water locations.

It is clearly a fact that the sand reserves currently maintained by sand dune mining operators will be exhausted - possibly within 20 to 25 years, contingent upon customer demand. Certain operators may exhaust their reserves in ten (10) years, or less. It is therefore readily apparent that if Michigan is going to continue to supply this resource, industrial sand will be produced at locations other than sand dune formations - UNLESS existing public ownerships (state parks or national lakeshores) are converted to mining sites.

High quality industrial sand is currently being produced in large volume at one inland mining site. This sand is being marketed for foundry (automotive) purposes and is apparently cost competitive with sand produced at sand dune mining sites. Mining and processing (beneficiation) techniques are similar to those utilized by their competitors. Information developed by the Department, through consultants, and statistical data brought forth by an industrial sand mining operator, confirm the fact that substantial quantities (millions of tons) of sand are available in inland areas for future utilization. However, it must be noted that the development of these reserves - when, and if this occurs--must be preceded with the construction of processing and shipping facilities. In addition, transportation to consumers must be available on a cost-competitive basis. It is also relevant to note the fact that an investment of one (1) million dollars (conservatively) may be necessary to achieve this conversion. Nonetheless, opportunities do exist for the future development of this resource by operators engaging in this enterprise. Opportunities for recovering deep-water sand deposits remain speculative, at best. The economics of such an undertaking are unknown as are the potential environmental impacts to the benthic elements of the Great Lakes. Substantial additional research and evaluation relating to this alternative remains to be accomplished.

The degree to which foundry sands are recycled for re-use in this industry is not well documented. It is, however, acknowledged that major foundries do recycle previously used sand - sometimes as many as 20 to 25 times. It is speculated that current costs associated with recycling techniques may exceed the cost of "new" sand to small foundry operations.

Land Matters

Data referenced in PHASE I of this preliminary report confirm the fact that public ownership of sand dune formations has expanded significantly over the past fifteen (15) years. Land acquisition projects by the Federal Government at Sleeping Bear Dunes National Lakeshore, the Federal and State Governments jointly participating in an acquisition project in the Nordhouse Dunes, and State acquisition efforts in Allegan County (Saugatuck Dunes State Park) and Oceana County (Silver Lake State Park) are efforts of special mention. Ongoing efforts to expand public ownership in Berrieri County (Warren Dunes and Grand Mere State Parks), Ottawa County (Kitchel Dune Preserve), and Emmet County (Sturgeon Bay Dunes) would expand public ownership even further.

Land acquisition costs for these projects are substantial , particularly when Great Lakes shoreline is involved in a particular assemblage of acreage. Furthermore, it is reasonable to conclude that the value for undeveloped dune lands will continue to increase in future years. Opportunities do exist for continuing public ownership acquisition projects. Acquisition may include "blocking-in" existing state projects, as well as the expansion of locally or privately administered areas. The likelihood of establishing new state projects is remote simply due to existing, and planned, private developments.

Land Use

There is clearly a deficiency in the adequacy of locally adopted land use regulations that pertain specifically to sand dune formations. Zoning plans vary dramatically from area to area, frequently ignoring the environmental values inherent in these geomorphic features. The absence of these types of controls has resulted in significant land use problems - homes threatened with major sand related erosion problems, dwellings subsiding into depressions, commercial developments constructed within barrier dune formations, and multi-family dwellings, condominiums, and apartments developed in areas of high environmental sensitivity. Furthermore, local units of government have established public recreational facilities which have in turn become subject to intensive uses, thereby creating additional land use problems.

In addition, a Department policy guiding management decisions, proposed public uses, developments and facilities that may be contemplated within sand dune areas is nonexistent. Individual Divisions apply general operating policies to these resources when site specific plans are considered for certain projects. The absence of a policy of this nature has resulted in the development - or proposed development - of facilities including major hardsurfaced parking areas, intensively developed campgrounds, roads, utility systems, and off-road vehicle, as well as snowmobile use within barrier dune formations. The structural integrity of these resources has been impaired by these uses and erosion-related problems have been created.

The operation of off-road recreational vehicles (excluding snowmobiles) is permitted in portions of the Silver Lake State Park, Oceana County. Existing state park policy provides:

"Miniature railroads, merry-go-rounds, Ferris wheels, pony rides, miniature pool and golf courses, and similar installations, are incompatible with the purpose of state parks. It is the contention of the Department that these features belong in fairs, circuses, and amusement parks--not state parks. Establishment of this type of development is not permitted." (Emphasis supplied.)

Off-road vehicle use in this park consists of two types; concession operated and authorized private vehicle use. This type of use has resulted in numerous personal injury accidents, as well as the loss of life. The compatibility of this authorized use with the aforementioned state park policy, in addition to potential public liability considerations, is deserving of re-evaluation; not withstanding the impacts that continued uses of this nature create upon the natural processes of plant succession in the affected portions of this barrier dune formation.

It is further acknowledged that snowmobile use is permitted on portions of state-owned lands lying within designated sand dune areas. In some cases, this use is permitted within barrier dune formations. The consistency of this policy with the desire to protect and maintain the integrity of these resources from impairment should also be subject to re-evaluation.

Forest management and wildlife habitat improvement projects have occurred on a very limited basis within designated sand dune areas. Areas of special interest - particularly from the perspective of wildlife research - are found on those state-owned lands located in the Beaver Island group. These islands, due to their remoteness and inaccessibility, continue to exhibit a high potential for various types of research-related projects. Management plans for these areas are deserving of "special" consideration in view of the potential for major habitat alterations that could result from a large scale timber harvest operation.

Phase III

This section of this preliminary report contains several recommendations for future action, some of which are contingent upon support and endorsement from the Governor and the Michigan Legislature. It is recognized that certain recommended actions may be controversial in nature and impact and affect to varying degrees individual citizens, organizations, public agencies, and industry. These recommendations have been developed with the instructions of the Governor and the Natural Resources Commission in mind. In Governor Blanchard's letter to Director Skoog he states:

"As the public official primarily responsible for the protection, management, and wise use of Michigan's resources, you are aware of the many threats to those resources and the competing interests for their use and preservation. As Michigan attempts to diversify its economic base, many are looking to Michigan's natural resources as a means of revitalizing the state's economy. While I am convinced that there is a role for natural resources to play in this effort, we must not lose sight of the fact that the significant natural resources which we in Michigan now enjoy must be protected for ourselves and future generations.

"For this reason, I am requesting that the Department of Natural Resources undertake a special program which will ultimately lead to the long-term protection of one of our most special natural features - Great Lakes sand dunes."

Likewise, in their request to Director Skoog that the Department direct its attention to this issue, the Natural Resources Commission stated:

"The sand dune formations which have been created and shaped by the forces of nature constitute one of the most striking features on Michigan's landscape. These fragile and irreplaceable resources represent a culmination of the effects of complex forces including wind, wave action, lake levels, and past glacial activity. The geomorphic structures that resulted, and the subsequent vegetation of those features, are the most significant and impressive dunes in the world."

Over the past century, development and mining have altered, or destroyed, many of the sand dune formations located primarily adjacent to the Lake Michigan shoreline. The Commission is deeply concerned over the likelihood of continuing loss and degradation of these resources.

The natural values of Michigan's coastal zone - in particular, the high relief barrier dune formations - is a subject that could easily be addressed through the written word in several volumes of publication. Neither time, nor financial support, would allow such an effort to be completed within these constraints.

First, and foremost, it must be noted that many of the following recommendations if implemented in total, or in part, can only be accomplished effectively with adequate revenue (budgetary) support. Resources management programs that impact sand dune formations are presently occurring on a "piecemeal" basis within the Department and among other public agencies. Frequently, resource management plans conflict with one another - even land acquisition projects are uncoordinated. One entity may be intent on "preserving" an area - the other may have plans for development and exploitation.

Conclusions

I. The coastal sand dune formations existing within the State of Michigan are a unique natural resource from a global perspective. In no other location, world-wide, does this combination of natural occurrences exist and present itself as it does in Michigan. These geomorphic features are youthful in age - geologically - yet are very sensitive to environmental disruption. They are unstable in physical character and are highly prone to erosion through the activities of man and the forces of nature. Coupled with their geological uniqueness is the type of indigenous vegetation that has developed within these environmental settings. Furthermore, sand dune formations are cherished by Michigan citizens, and visitors to our State, because of the aesthetic qualities contained within them. Natural beauty, opportunities for solitude, spiritual refreshment, color, sounds, prominences and vistas, and the interaction of land with water are ingredients that these resources offer for public use and benefit. Research projects of various types have documented these values in significant and substantial detail. Sand dune environmental systems exhibit a multiplicity of ecosystems and features including wetlands, lakes, streams, high elevations and deep plunging valleys, sterile and barren 'blow-outs," and rich mature or maturing overstory vegetation. Frequently these systems exist with one-another within relatively small areas, thereby creating transition zones (ecotones) of special interest to the scientific community. This combination of factors supports the conclusion that sand dune formations - as a total resource - are the most sensitive environmental systems in Michigan.

II. The removal of sand (sand dune mining) from within designated sand dune areas is likely to continue at existing (operating) locations. The longevity of these operations is contingent upon the following factors: (1) recoverable reserves at each mining site; (2) technological changes initiated by the foundry industry; and (3) economic factors (competition, transportation, and labor costs). Substantial quantities of industrial sand deposits exist in areas other than sand dune formations. The development of these reserves would necessitate capital investments for processing facilities and the ability to transport the material to the "market place" on a cost competitive basis. "Inland" and "dredge[1]' sands have been, and are being, utilized by the foundry industry. These sands do require modifications to the "casting processes changeover is not, however, an insurmountable obstacle. Numerous other states in the Midwest, and elsewhere, produce and market industrial sand. If industrial sand production in Michigan was concluded, other states could meet market demand but in higher costs to the consumer.

III. There is clearly a deficiency in land use controls associated with potential or proposed private developments within sand dune areas. Zoning plans and locally adopted regulations are inconsistent on a

statewide basis. Opportunities exist for expanded high density residential development in currently undeveloped "barrier dune formations." The Department has very limited legal authority to determine the highest and best use of these resources. While the Department currently possesses the authority to regulate - even prohibit - the removal of sand for commercial or industrial purposes because of environmental degradation, it cannot apply this same standard to other types of contemplated land use practices where disruption may exceed that of a proposed mining operation. The only legal recourse available to the Department (or any other party) is through the initiation of a legal action pursuant to the provisions of the Michigan Environmental Protection Act.

Similarly - perhaps, even more importantly - there is clearly a void in Department policy regarding proposed uses or developments involving land, or minerals (including oil and gas) on state-owned lands, lying within sand dune areas. Likewise, grants to local units of government may finance projects that disrupt, or impair, the integrity of these resources. It is only in recent years that public pressures have held in abeyance expanded developments and uses on publicly-owned sand dune formations.

IV. Public land acquisition projects have continued significantly over the past several years. Revenues provided through the Kammer Land Trust Fund have financed these efforts in large part. The citizens of Michigan are fortunate to claim title to a significant percentage of our coastal sand dune formations-State and Federal ownership alike. Nonetheless, opportunities exist to continue this effort in future years. New projects, and expanded public ownership within existing projects, remain to be accomplished.

Changes in existing law, policies, or operating procedures restrict, expand, or impact pre-existing practices. There are those who support change... .and, others that oppose it; some vigorously

The long-term protection of Michigan's sand dune formations can be achieved by implementing a number of changes and modifications to current statutory authority, Department policies and procedures. The foregoing recommendations parallel the intent contained within the requests of Governor Blanchard and the Natural Resources Commission addressing this subject. Recommendations relating to amendatory legislation, budgetary support, and land acquisition projects can only be achieved with the support of the Governor and the Michigan Legislature. Other modifications can be established through action by the Natural Resources Commission as authorized under existing authority. Obviously, the citizens of Michigan have a vested interest in this matter - the coastal zone embraces a variety of natural resources that have irreplaceable value to the use and enjoyment of future, as well as present, generations. In year's past, the "virgin" conifer and hardwood forests of Michigan were exploited to their absolute and full potential for the purposes of economic gain by timber interests. Millions of dollars and thousands of "person years" have been required to rebuild the character of Michigan forest lands. Rivers, streams, lakes - including the Great Lakes--were utilized for the purposes of transporting residential and industrial waste products to "far-away places." Solid wastes, likewise, were buried all about the landscape - out-of-sight; out-of-mind!

The mistakes of year's past as to how Michigan's resources were abused, and misused, are being corrected, however, at significant costs to society. The quality of our vast water-related resources has been substantially improved; waste disposal techniques continue to be developed; and, renewable resources are being "renewed."

Such is not the case with Michigan's sand dune formations. The forces of nature that created these magnificent resources cannot be duplicated through the efforts of human ingenuity. It is, therefore, appropriate that steps be taken to protect these features from future impairment, degradation, and eventual destruction.

It is Recommended that:

I. Steps be initiated immediately to secure funding support in an amount necessary to administer a Sand Dune Management Program within the Department.

II. Amendatory legislation be prepared to expand the provisions of the Sand Dune Protection and Management Act. This legislation shall be comprehensive in nature and provide the Department with the authority to establish criteria (administrative rules) for the purposes of controlling proposed private land use practices within designated sand dune areas. Local units of government shall be required to establish such controls within an appropriate time period that are subject to the approval of the Department. In the event that local controls are not adopted, the Department would then be authorized to establish

appropriate restricted uses within designated areas.

III. Research programs shall be re-established addressing sand as a mineral resource in areas other than sand dune formations. In addition, research projects focusing on the environmental and ecological values located within specific sand dune areas should be continued. Particular emphasis should be directed toward the stabilization, reclamation, and re-vegetation of previously disturbed, impacted, or affected dune-type areas.

IV. Land acquisition projects involving sand dune areas - barrier dune formations in particular - shall be given high priority consideration for funding support. Acquisition projects shall be based upon environmental values rather than development potential.

V. Wherever possible, existing undeveloped state-owned sand dune formations exhibiting significant environmental values or offering high aesthetic qualities should be designated as "natural areas" for appropriate recreational, educational, or research purposes. Dedication of such lands should be accomplished in accordance with the provisions of the Wilderness and Natural Areas Act or other appropriate means to assure long-term protection.

VI. State-owned minerals located within designated sand dune areas shall not be leased for development purposes. Furthermore, where mineral ownership has been severed from state-surface ownership, priority consideration shall be given to consolidation of state ownership in those cases. The protection of the surface values of designated sand dune areas from the potential impacts of proposed oil, gas, or mineral well drilling operations and seismic exploration shall be given priority consideration when evaluating such projects. Particular concern shall be given to any such contemplated activity within barrier dune formations.

VII. A comprehensive Natural Resources Commission Policy addressing proposed management plans, land use practices, or developments affecting barrier dune formations on state-owned land shall be prepared for future consideration by the Commission. During the pendency of the adoption of this policy, all actions incorporated within such plans contemplated within these areas shall be held in abeyance. The proposed Commission policy shall include no less than the following areas of concern:

A. The type and nature of timber sales or proposed habitat improvement projects.

B. Specific restrictions to control vehicular and pedestrian access.

C. An in-depth re-evaluation of the continued use of off-road recreational vehicles on state-owned land (excluding snowmobiles).

D. Restricted snowmobile use and operation.

E. Criteria for funding grants to local units of government where these formations are included in a proposed project boundary.

F. Proposed utility systems or rights-of-way.

G. Land exchanges.

H. Harbors of refuge, marinas, or water access sites.

VIII. Secure funding support for the inclusion of all information pertinent to designated sand dune areas into the Department's Land Inventory Program.

The preparation of a Final Report addressing this subject is recommended and should be initiated at the earliest time possible. While the foregoing does include and embrace a substantial amount of background information and observations, it is acknowledged that other contributors could add immeasurably to the completeness of such a report.